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An application of value analysis concepts toward more efficient attainment of fighter squadron objectives

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Submitted in partial fulfillment of
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ABSTRACT

During the last two decades, Value Analysis/Engineering has emerged as an effective cost reduction discipline in product refinement, purchasing, and national defense. Within this paper, the concepts and methods of application of Value Analysis/Engineering are reviewed. The process of Value Analysis is considered to be applicable to a fighter aircraft squadron for the purpose of achieving higher combat readiness within time and resource constraints. A basic plan is presented to provide the fundamental structure and method of implementation of the technique for squadron organizational improvement.

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CHAPTER I

INTRODUCTION

Due to the extreme flexibility required of a carrier based fighter aircraft squadron, inefficiencies creep into the organization and are sometimes retained and undetected over a period of time. An improved system for discovering and correcting these inefficiencies would aid in the maintenance of a higher level of combat readiness.

A relatively new discipline has been developed which is known as value analysis/engineering. Value analysis has primarily been applied to purchasing and product improvements, however, it is a method of thinking which might be applied to any functional organization for the purpose of devising more economical methods to achieve desired goals. Through application of value analysis techniques, many American corporations have saved large sums of money from the resulting recommendations which have induced higher efficiency in production and procurement.

I. THE PROBLEM

Statement of the problem. It was the purpose of this study (1) to review the concepts of value analysis/engineering; (2) to describe the techniques of application of value analysis/engineering; (3) to review the present business applications of the discipline; (4) to discuss the value analysis/engineering method as a systematic thought process, and (5) to formulate a manner to apply the value analysis procedure to a fighter squadron organization with the goal of achieving greater efficiency as a functional unit.

The measure of efficiency is level of combat readiness attained within fixed time and resource constraints.

The authors believe that the use of new concepts such as systems analysis, value analysis, and quantitative decision techniques can be mated to computerized and manual reporting systems to form a more effective plan for squadrons to determine conditions which create the highest probability of optimum performance within time and resource constraints. Value analysis may be a useful tool in forming the framework for such a plan of maintaining organizational effectiveness. The worth of value analysis can be ascertained only by time and diligent effort toward that goal.

Social purpose. If the techniques of value analysis can be feasibly applied to fleet squadron organization the squadron personnel will benefit by more efficient use of time and elimination of some of the tasks which produce little toward readiness goals. The squadron would benefit by reaching a higher level of readiness within the imposed time and resource constraints. The nation would benefit from a more formidable total defense team realized from their investment. Finally, it is the wish of the authors that this study may serve as reference to those who pursue the subject as techniques of value analysis for organizational refinement become more developed.

Significance of the study. This study will differ from others known to the authors in that the techniques of value analysis will be adapted to the purposes of revision of organizational structure and methods of management rather than improving physical items or guiding procurement of supplies.

The reader is cautioned that the conclusions reached and the technique modifications made will be designed for a fighter aircraft squadron and may not apply directly to another organization. Though a strategy will be mentioned for installing the use of value analysis techniques within an organization, no effort will be made to evaluate the numerous possible strategies for selection of the optimum method.

II. DEFINITION AND BACKGROUND OF VALUE ANALYSIS

Definition of value analysis. Value analysis/engineering, as it is known today, has been active on the business scene since about 1947.[1] However, confusion abounds as to the exact definition of the term. To clarify the term a definition from an article by Carlos Fallon in the book, Value Analysis/Engineering, The Implications for Managers, is presented.

> ". . .What is value analysis? What is value engineering? What is value in this context? The terms as they have been increasingly used since 1949, refer to economic value--most frequently to the economic value of industrial products. But their use has not been limited to product values. Value analysis is a recognized part of economic analysis. The term is also used with respect to production management. The scientific study of value is also an integral part of systems engineering.
>
> The value analysis and value engineering that I will attempt to define in this chapter is the modern industrial technique for scientifically relating product worth to product cost-a technique originated by Lawrence D. Miles of General Electric in the late 1940's. Under his guidance and sometimes to his amazement-the technique has developed a variety of approaches, each adapted to the industry it serves. All these approaches, however, have one thing in common--they are concerned with providing good

[1] Joseph L. Mazel, "Value Analysis Moves Into Plant Operations," Factory, 122 (April 1964), 74.

value for the customers dollar, at a fair profit to the supplier, by investigating what the product does in relation to the amount of money spent on it. Some use a group dynamics approach, others prefer the individual approach; but all approaches are concerned with the function rather than the structure of the product.

Precise definition, however, is not a simple task, as Russell L. Ackoff has pointed out. We can simplify the task somewhat by explaining just what we mean by terms used in the definition itself. The term value analysis will be used as it is used by Lawrence D. Miles to describe what I have been calling, up to this point, value analysis and value engineering. In the preface to his book he says, "The terms value analysis and value engineering are used synonomously." Synonyms, however, do have different connotations. We will get to that later; but for purposes of this discussion, value analysis will cover both value analysis and value engineering.

The word "value" will be used in the sense which it is used by the world's greatest manager of economic resources, the American housewife. Later on, we will call upon lesser economists, more men, to give us a definition of value easier to grasp by the prosaic masculine mind. For the moment, value will mean exactly what the housewife says when she says, "This is a good value." We do not intend to change the meaning--simply to understand it a little better.

"Product" will be used to describe whatever we give the customer for his money, whether it is a physical product or a service; and "product worth" will describe those attributes of the product which the customer wants--not the structural sense of what the product is, but in the functional sense of what it does. The expressions "evaluate the function" and "put a dollar sign on each function" describes methods of quantifying product worth.

The term product cost will include all the resources that must be utilized to provide what the customer wants. Paramount among these is the elapsed time in the design, procurement, manufacturing, and marketing cycles.

VALUE ANALYSIS AND VALUE ENGINEERING DEFINED

Now we can attempt a definition.

> Value analysis/value engineering is a functionally oriented scientific method for improving product value by relating the elements of product worth to their corresponding elements of product cost in at least cost in resources."[2]

Carlos Fallon provides an adequate basic understanding of the terms value analysis and value engineering.

There are two factions in the method of defining the two terms; one which uses the terms value analysis and value engineering synonomously and another which uses value analysis to denote value work done after commencement of production and value engineering to denote value work done during the design phase.[3] Regardless of the point in time when application of analysis occurs, the process for value work remains essentially the same. For purposes of this paper the term value analysis will be used in exclusion of the related terms for value work and will be assumed to be synonomous with those terms.

Background. Value analysis has come of age.[4] The process and results of value analysis are proven to be of significant benefit to many organizations including the Department of Defense. The Department of Defense is emphasizing to all participants in the nations defense effort that there is an increasing need for

[2]William D. Falcon, Value Analysis Value Engineering The Implications for Managers (New York: American Management Association, 1964), pp. 9-10.

[3]Walter E. Linthicum, "Value Engineering: Intensified Cost Reduction" (unpublished Master's thesis, George Washington University, 1962), p. 1.

[4]Ibid., p. 55.

major cost reduction.[5] Value analysis is one of the important techniques designed to achieve that particular result.

The perpetuation of an efficient value analysis organization is of prime importance to contractor and government alike. The government has designed various incentives to reward those who achieve significant results. Defense contractors now share in the profits realized from efforts of an effective value analysis program in addition to gaining an improved competitive position in obtaining new business. Department of Defense industrial and procurement activities are officially recognized for increased efficiency and total cost reduction from applying effective value analysis programs.[6]

The most impressive singular event of savings realized from application of value analysis found by the authors was made by the Martin Company. Martin saved a total of sixty-five million dollars through total value analysis on a missile production project.[7] There are numerous other examples of the profitability of the value analysis technique.[8]

Value analysis has been proven as a management tool of significant worth. Although value analysis seems to be a powerful management tool, it is actually much less pretentious than it sounds since it involves nothing more than a systematic, searching

[5]Office of the Assistant Secretary of Defense (I&L), Value Engineering, (Washington: Government Printing Office, 1963), p. iii.

[6]"VE's Profit Potential Raised," Engineering News Record, 172:17-18, November 5, 1964.

[7]"How Martin Saved $65 million via Total Value Analysis," Steel, 154:98-101, June 8, 1964.

[8]Engineering News Record, loc. cit.

scrutiny of the design and cost of products. The approach to cost cutting accentuates the system in terms of the function it must perform. In view of the implied potential of value analysis, the authors feel that the question of applicability of value analysis to a Naval aircraft squadron must be resolved. If the technique appears to be feasible, the extent and method of application must be defined.

CHAPTER II

REVIEW OF THE LITERATURE

Prior to the development of a means of applying value analysis towards the ends described in the first chapter, a review of the study is presented. First, an amplification of the definition of the term coupled with example cases of application is proferred for an understanding of the term and a "feel" for the steps used in previous applications. Second, some of the broad applications in industry and within the Department of Defense are tendered to further acquaint the reader with specific adaptations of the techniques and relate examples of the degree of success in using value analysis.

I. SELECTION CRITERIA

In reviewing the available literature to clarify the concepts of value analysis the authors used the following selection criteria. Since the use of value analysis in industry did not commence until about 1947, only those books and papers which were published after 1945 were reviewed. Due to the fact that most information of value from early periodical literature seemed to be included in texts, only the periodical publications issued after June 1962 were considered.

II. THE CONCEPT OF VALUE ANALYSIS

Value analysis was defined in chapter one as

> ". . .a functionally oriented scientific method for improving product value by relating the elements of product worth to their corresponding elements of product-cost in order to accomplish the required function at least cost in resources".[9]

[9]Falcon, loc. cit.

Value was presented from the point of view of the American housewife. Actually the word "value" implies different things to different people. The value gained from a specific item may be realized for entirely different reasons for different people. In any case the word "value" should not be confused with the words "price" and "cost" when used in context with value analysis.

Value is a broad term which can be conveniently reduced to a small number of terms. Lawrence D. Miles has described value as encompassing the following spectrum of definitions.

> "1. Esteem value: The properties, features, or attractiveness which cause us to want to own an item.
>
> 2. Use value: The properties and qualities which accomplish a use, work, or service.
>
> 3. Cost value: The sum of labor, material, and various other cost required to produce it.
>
> 4. Exchange value: Its properties or qualities which enable us to exchange it for something else we want."[10]

Miles further points out that only the first two terms are applicable to a value study. In other words, a value study emphasizes the functional value in context with performance and desirability or "esteem".

Value in conjunction with value analysis is a tool for identifying and eliminating unnecessary costs, so, value may be thought of as a measure of the appropriateness of the cost of an item. Miles further describes value as ". . . the minimum dollars which must be expended in purchasing or manufacturing a

[10]Lawrence D. Miles, Techniques of Value Analysis and Engineering, (New York: McGraw-Hill, Inc., 1961), p. 3.

product to create the appropriate use and esteem factors".[11] Use value sought by value analysis is the lowest possible cost for providing a function and esteem value sought is the lowest cost of providing the appearance attractiveness and features which the customer wants.

There are essentially two "levels" of value which may be thought of as maximum value and normal degree of value. Achieving maximum value is analogous to reaching a level of existence which will insure perfect happiness. It is probably never realized.

> "The degree of value in any product depends on the effectiveness with which every usable idea, process, material, and approach to the problem have been identified, studied, and realized."[12]

The purpose of the special techniques of the school of value analysis is to bring more of the better value combinations into focus while maintaining an expenditure of time and resources which is as low as possible. A better than normal degree of value is achieved when a product is a composite of better combimations of ideas, functions, materials, and perhaps more accepted advertising than that of competing products. These more optimum combinations are not achieved through randomly eliminating obvious fallacies in production but are the fruits of an organized effort using value oriented tools for ascertaining better methods and materials.[13] If a business is to survive in

[11] Ibid.

[12] Ibid.

[13] Ibid., p. 4.

this free enterprise system, it must continually offer the customer the best value for the market price unless a position of pure monopoly is enjoyed.

Perhaps the importance of value analysis can be better depicted by illustrating the generally accepted product maturity cycle. The first figure, which shows sales versus time during research and development, growth, and maturity, illustrates the locus of points described by a successful product which retains its desirability over a period of time. The second figure indicates the area of uncertainty, given that initial success was realized. This particular area is the time period when value analysis can be brought into operation to enhance the changes of continued success.

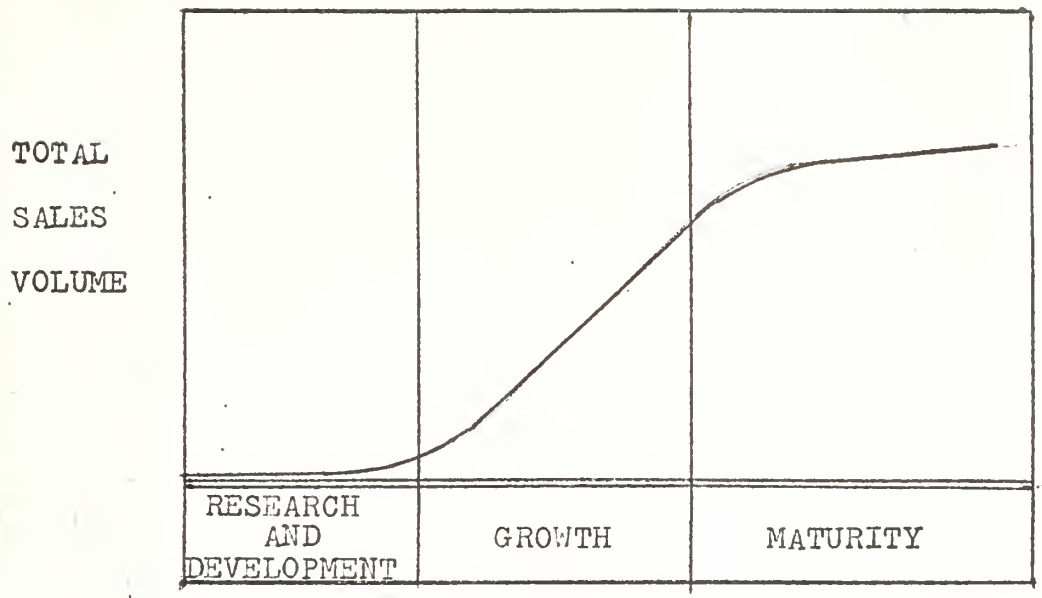


FIGURE 1

PRODUCT MATURITY CYCLE
(FROM MILES: TECHNIQUES OF VALUE ANALYSIS AND ENGINEERING)

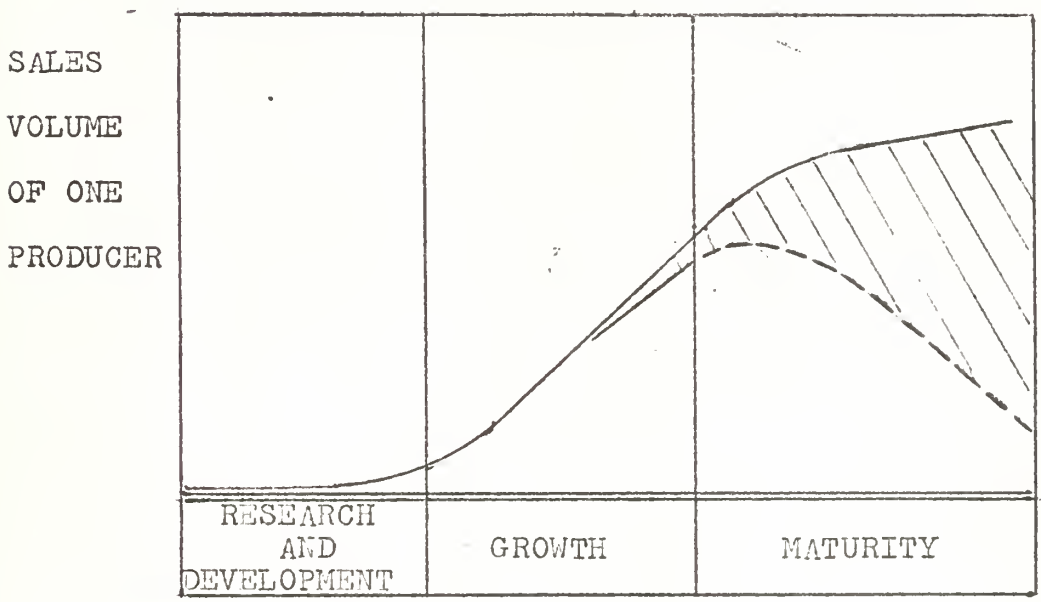


FIGURE 2

EFFECT OF TIMING AND DEGREE OF CHANGE FROM PERFORMANCE-ORIENTED SKILLS TO VALUE-ORIENTED SKILLS ON SALES VOLUME OF ANY ONE PRODUCER. SHADED AREA SHOWS EXTENT TO WHICH PRODUCERS SALES ARE CONTROLLED BY HIS DECISION IN THIS MATTER (FROM MILES: TECHNIQUES OF VALUE ANALYSIS AND ENGINEERING)

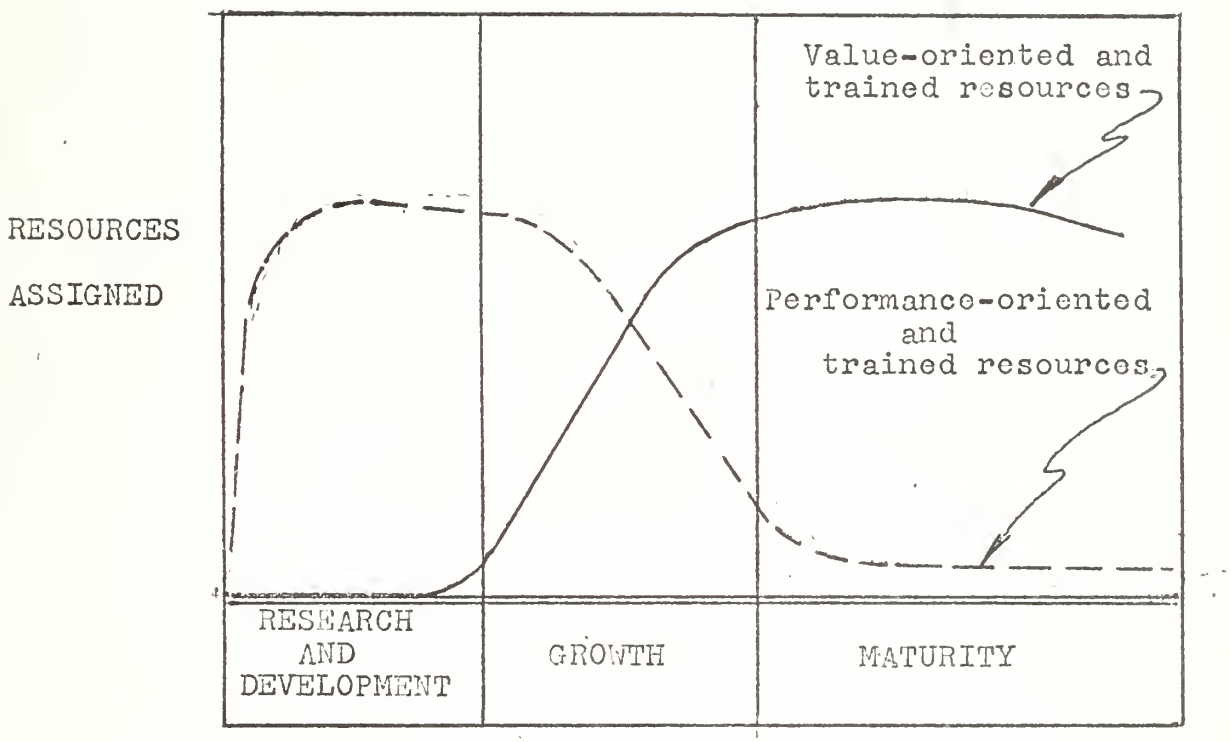


FIGURE 3

OPTIMUM CHANGE IN USE OF PERFORMANCE ENGINEERING AND VALUE ENGINEERING SKILLS AS PRODUCT MATURES.
(FROM MILES: TECHNIQUES OF VALUE ANALYSIS AND ENGINEERING)

The third figure shows the change in use of engineering and value analysis as a product matures as described by Lawrence D. Miles. At a products conception, it is born of performance-oriented effort and during the growth cycle improvements are made. During the period of maturity, high use of value oriented resources must be applied for product survival in a competitive market. The squadron is analogous to the product in the mature stage. The squadron, of course, produces new functions which must complete a full growth cycle.

The nature of value analysis and the time in the life cycle of a product have been presented, but no mention has been made as to who contributes to performance and value of an item. Actually all persons involved in the production of an item are responsible, in part, for the performance of that product and they contribute to the value of the product in their own area. The end product is, in the opinion of the producers, what will provide the customer with the desired performance and proper degree of esteem value at a price which is acceptable to both parties.[14]

It is extremely difficult to accurately measure the worth of value oriented work at any stage in the process. If performance is not up to standard, tests will reveal the fact to the producers. On the other hand, if value oriented work causes esteem value to reach a level of low acceptability at the market price, there is no immediate method of discerning this evidence. Though it is difficult to discern worth of esteem oriented value

[14] Ibid., p. 9.

work, it is a recognized part of value work.[15] Personnel working in this area need a broad understanding of the market in terms of human reaction toward certain products. Now, the purpose of value analysis can be expanded to include provision of most esteem and performance at a fixed price or a fixed level of esteem and performance at the lowest possible price.

III. METHOD OF APPLICATION OF VALUE ANALYSIS

Miles has outlined a very basic method for applying value analysis to the problem of developing a more economical manufacturing process for a product. The process involves the following three steps.

1. Identify the function of the product.
2. Evaluate the function of comparison.
3. Cause alternatives to be developed which will perform the same function.[16]

Identifying the function is usually a simple process for describing an item. A kitchen stove will be used as an example. The stoves primary function is to provide heat for the purpose of cooking food. However, it may have sub-functions such as to heat the house, provide an attractive appearance, or to perform as a water heater. Each part of the stove must be analyzed as a functional part of the stove.

To determine if the function is reliably accomplished at the lowest possible cost, comparisons must be made. Such questions as: "Can it best serve its function utilizing gas, coal, electricity, or fuel for energy?", must be considered. If there is no

[15] Ibid.

[16] Ibid., p. 14.

comparison to be made, there can be no evaluation of the product which would have any meaning.[17]

The third and final step is to develop value alternatives with some systematic searching process. During the search, attention must be focused on function and not merely on a material, part, or device without regard for the number of alternatives available.[18]

To advance beyond the rudimentary stage of value analysis technique, the value analysis approach which seems to be the basis for all programs reviewed by the authors is stated in the words of Lawrence D. Miles. The basic process consists of five steps.

"1. What is the item?

2. What does it cost?

3. What does it do?

4. What else would do the job?

5. What would that alternative cost?"[19]

When answers to these questions are formulated, the foundation for objective data to be presented to top management is framed.

The first two questions, "What is the item?", and "What does it cost?", are readily determined from objective data on the third.

The third question requires more than a cursory observation, for it forms the basis for the analysis. A penetrating search may

[17]Linthicum, op. cit., p. 9.

[18]Miles, op., cit., p. 17.

[19]Ibid., p. 18.

be required in order to determine an accurate functional purpose for the item. For example; an electrical switch box cover may be decoration, insulation, a dust cover, a color coded circuit identifier, or it may serve some other function not mentioned. If the necessity of the function and the identity of the function can not be determined accurately, there will be a fallacious basis for forming comparisons.

"What else would do the job?" It is Mr. Miles intention that this question be answered with a diligent search for all possible alternatives. This particular step will reveal the expertise and creativity of the analyst and it is never answered to an absolute degree. There is always another scheme to gain the desired function.[20] L. D. Miles has outlined an organized plan for searching for alternatives which includes the following actions.

1. Study handbooks.
2. Review available trade literature.
3. Telephone people who might have pertinent information.
4. Write to specialists and to companies who might have knowledge of effective alternatives.
5. Focus intense creativity sharply on the precise task to be accomplished.
6. Refine the results of these creative sessions and search further for additional information.[21]

The intensity and quality of effort in this creative problem will determine the success of the value analysis.

[20] Ibid.

[21] Ibid.

"What would that alternative cost?" A thorough study of all cost involved in procurement and production is largely attained through examination of current estimates from reliable sources. This area is one which requires more expertise in human relations since generation of estimates is frequently met with dissention when definite plans for procurement are not in effect.

It appears--and correctly so--that one need not command a great variety of manipulative techniques in order to complete a profitable value analysis.[22] In the hands of experienced product engineers, value analysis has become a truly professional tool for improving the competitive position of a company.

Cursory examination of the technique as presented by Miles may lead the reader to believe that it is merely another way of using the scientific approach to solving a problem. Perhaps it is, but, it is apparent that the emphasis on functional analysis is a formula for success verified by the examples at the end of this chapter. In order to demonstrate to the reader exactly how the value analysis technique is applied to a real product, a case extracted from a value analysis text is included as appendix one.

Numerous modifications and adaptations of the basic questions to apply in an analysis have been made to Miles' method. Most of the modifications reviewed by the authors contained the essence of the five steps of the value analysis approach and all of the value analytic programs maintained a strict orientation toward evaluation of function and search for a functional equivalent at

[22]Linthincum, op. cit., p. 53.

a reduced cost. Miles' particular mode of application of value analysis was presented because no basic improvements to his outline were noted in other literature. The dynamic approach toward function is the key to repeated successes of organizations who use value analysis.[23]

IV. THE STRATEGY OF VALUE ANALYSIS

Value analysis seems to be an aid in making products better but how is this task accomplished in less time with the same people?

> "Value analysis. . .does this because it provides a strategy to meet the challenges of concurrence, proliferation of specialties, and scientific allocation of resources."[24]

Use of value analysis brings the right specialists together at a profitable time and supplies them with the tools to relate the physical traits of their product to the economic characteristics of their product.

> "Fruitfully bringing diverse skills together at the key decision points in the life of a product, identifying and reconciling differences in interest and appealing to common motives constitutes a management strategy."[25]

This strategy may be applicable to making the organization more functional while retaining or improving the esteem value of the organizational entities.[26] This conjecture will be discussed in chapter four.

[23]Miles, op. cit., p. 8.

[24]Falcon, op. cit., p. 84.

[25]Ibid.

[26]Authors' conjecture.

V. APPLICATION OF VALUE ANALYSIS IN INDUSTRY

The success of value analysis techniques is verified by the following examples. The reader may also gain some insight to the present types of value analysis application.

Storage costs were reduced eighteen thousand dollars annually for a division of the Aero-Jet General Corporation as the result of value analysis.[27] The American Bosch-Arma Corporation will net a savings of twenty-six thousand dollars per year due to processing changes of a drive shaft resulting from value analysis.[28] A value analysis team made recommendations to a division of the Sperry Gyroscope Company which resulted in savings of over ninety percent of the operating cost of a type of equipment.[29] A Navy value analysis team made recommendations which resulted in estimated savings of one hundred ninety-seven thousand dollars on the foundation of a multi-story building.[30] It is felt that a factor in General Electric's position in industry today is the continuing value analysis program which they sponsor.[31] Some claim that a realistic average for the return on money invested in value analysis is fifteen to one with some projects paying as high as sixty to one.[32] The figures are

[27] Mazel, op. cit., p. 75.

[28] Ibid., p. 76.

[29] Ibid.

[30] "VE's Profit Potential Raised," Engineering News Record, 172:18, November 5, 1964.

[31] Edward Blake, "Using Value Analysis Throughout the Company," Management Review, 62-65, November, 1964.

[32] "Something of Value," The Economist, 211:507, May 2, 1964.

impressive. Success of the value analysis technique is indeed a unique achievement. Instances of failure are few and they are generally attributed to lack of management's total commitment.[33]

Value analysis is finding its way into various projects within the jurisdiction of all services through the programs sponsored by the Department of Defense to realize greater economy in defense contracting and procurement. Early in 1964, the value analysis incentive clauses included a "one-shot" opportunity for contractors to share profits in savings realized from cost saving designs. Recent revision of this philosophy allows the contractor to share savings when the cost savings designs are repeated. To further stimulate the value analysis program, the regulation which previously excluded engineer-architect type contracts from containing value analysis incentive clauses has now relaxed restrictions to a slight degree. It now states that "normally" incentive clauses will not be included in those contracts. Indications are that the architects and engineers will be included in the value analysis incentive program on occasion.[34]

Top management in the Department of Defense as well as industry, has difficulty in assimilating the many new concepts in management, including value analysis, into the present organization. The concepts usually do not justify autonomy within the Department of Defense as an office established for the purpose of forwarding the particular discipline. At one

[33]Ted Metaxas, "Where You Can Go Wrong On Value Analysis," Purchasing, 56:78-79, January 27, 1964.

[34]Engineering News Record, loc. cit.

time the Department of Defense attempted to accommodate these new fields by originating an office for applications engineering. This apparently was unsuccessful.[35] Though value analysis is not operating at a level at which its full potential may be reached, it is generally accepted as profitable and gaining momentum in number of applications.

VI. FRINGE EFFECTS OF VALUE ANALYSIS

Examining the monetary gains from improvement of a specific item is not a valid evaluation of the effectiveness of the technique operating within a total system. Side effects from a change resulting from a value analysis may outweight the improvement in a single area.

A report by the Technical Subcommittee of the Special Committee on Value Engineering of the American Ordnance Association was made for the office of the Assistant Secretary of Defense to determine the fringe effects of value analysis in a number of completed projects. A portion of the report is included as Appendix II. The findings indicated that only about two percent of all considered fringe effects could be considered to be a detriment to the organizations involved.[36] This indicates that value analysis, when properly applied, has a high probability of creating a total beneficial effect on the operations of an organization.

[35] R. S. Mandelkorn, Value Engineering 1961, (Elizabeth, N. J.: Engineering Publishers, 1960), p. 94.

[36] Department of Defense, Fringe Effects of Value Engineering, A Report by the Technical Subcommittee of the Special Committee on Value Engineering American Ordnance Association (Washington, D. C.: Government Printing Office, 1964), pp. 9-17.

CHAPTER III

VALUE ANALYSIS AS A THOUGHT PROCESS

Since the beginning of recorded history, man has been seeking better ways to do things. In recent years this quest has extended into design of thought process to enable man to think methodically and efficiently toward the solution of a particular problem. The scientific method is probably one of the most broadly recognized mental tools of this sort.

The scientific method has been expressed in many forms, but still retains the following steps as a basis.

1. Does a problem exist?
2. If so, state the problem.
3. Mentally create all possible solutions.
4. Suppose, through reason, which proposed solution is most likely to succeed.
5. Test that solution to determine validity.
6. If the first test fails, try the next most likely solution.

This method is still valid for problems which are amenable to a test situation and with slight modifications may be used for any problem.

Value analysis is also a thought process. It is actually not revolutionary in the sense that no omnipotent craft is included to automatically determine more economical solutions. The value analysis process has as its basic orientation an element which has not previously been subjected to the intense scrutiny that the technique brings to bear. Function is that element. The results of the value analysis thought process still depend upon the human trait known as creativity.

The steps in the value analysis thought process are re-iterated in a basic form.

1. What is the problem? (must be applied to a functional item or entity)
2. What does it cost? (may be in dollars, time, manpower, etc.)
3. What is its function? (reason for existence)
4. What else would serve the same function?
5. What would the alternatively cost? (may be in terms which differ from step two, but a comparative utility must be determined to equate the alternatives)

The least cost alternative will be concluded to be of higher value than all other alternatives.

In the opinion of the authors, the value analysis technique as a systematic method for organizing the thought process may be used by laymen as well as skilled professional personnel. It is applicable to almost any object, routine, or organization which was, or is being created to serve in a functional capacity. The layman may lack the broad experience desired to accomplish the development of a number of alternatives, yet due to practical experience in a specific area, have the most concise understanding of the function under surveilance and a realization that the function may be secured more economically.

The value analysis of tomorrow may become an abstract technique or thought process which will be generally known and employed. At that time the modification of the scientific method known as value analysis may reach its full potential of benefit to mankind.

CHAPTER IV

THE VALUE ANALYSIS PLAN FOR A SQUADRON

I. Preparation Phase

Now that the definition, methodology, and though process of the concept of Value Analysis have been discussed, it is time to consider the process of implementing it into the internal workings of an organization. The organization chosen is a typical navy fighter squadron. The present day fighter squadron is comparable to a business organization with a yearly budget of 1,500,000 dollars and whose assets approach 18,000,000 dollars. Although the return on these assets cannot be measured by a profit figure, the efficient use of these assets and the expenditure of its manpower, material, and budgeted allocation of resource are of utmost importance. As set forth in U. S. Navy Regulations, 1948, chapter 7, "the Commanding Officer is charged with absolute responsibility for the safety, well being, and efficiency of his command." There are no limitations prescribed by law or Navy Regulation that prohibit the Commanding Officer from utilizing the span of management techniques or advanced management theories in the performance of his duties. On the contrary, it is the manager that understands and appreciates the fundamental principles of management and knows how to apply them that substantially governs the degree of the over-all performance of his command. This degree of performance is the "value" of the organization.

It would be folly to state that any commanding officer does not have a plan of action for the betterment of his outfit. Further, it would be folly to state that the implementation of

Value Analysis will solve all his problems. In substitution for a discussion on how to sell "top management" on the idea of value it will be assumed that the concept will be accepted with varying degrees of recourse. As pointed out in chapter two, the effectiveness of Value Analysis involves the utilization of many known management tools and techniques. Organization of these tools and techniques in a manner which permits systematic application represents, in part, the "newness of value analysis".[37]

In the opinion of J. S. Miles in his Treatise on Political Economy, a neat summarization of the application of value is as follows:

> "Happily there is nothing in the laws of value which remains for the present or any future author to clear up; the theory of the subject is complete. The only difficulty to be overcome is that of so stating it as to solve by anticipation the chief perplexities which occur in applying it."

In the present day fighter squadron the over-all objective is to maintain a high degree of combat readiness. The amalgam of efforts required to attain this objective involves the unification and coordination of the many functional elements of the organization. The structure of the squadron is departmented according to its subfunctions, such as the Operations Department or the Maintenance Department. Each department is further reduced to divisions, shops, or individual job functions. Therefore, in the preparation phase for the value approach, it is the Commanding Officer's function to explain to all men in the squadron what Value Analysis is and what it can do for the organization. For

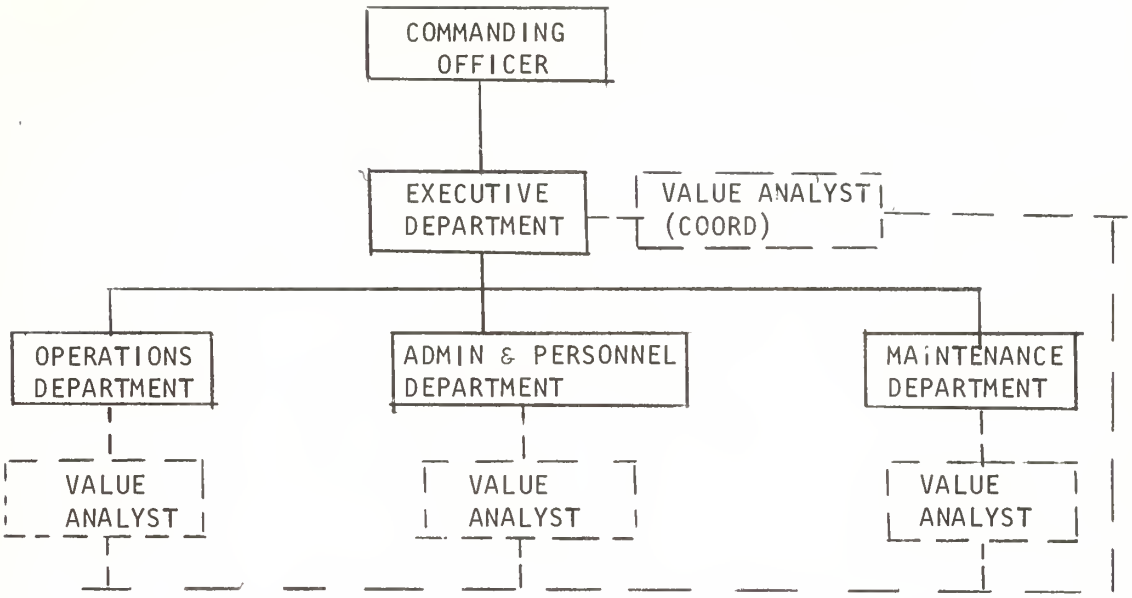
[37]Carl Heyel, "Value Engineering," The Encyclopedia Of Management, Vol. II, 1025.

each individual three simple questions need to be answered. (1) What is the function of my job? (2) How does it fit into the over-all plan? (3) What can I do to improve the contribution of my job? If each man, whether enlisted, officer, or the Commanding Officer, can orient himself about these simple questions then the "foundation of Value Analysis" is underway.

It is the purpose of this chapter to integrate the concept of Value Analysis in the squadron organization. Through this concept a plan of action will be presented that is directed toward the achievement of the over-all squadron objective, combat readiness.

II. Organizational Phase

After studying the typical organizational arrangements of the fleet type squadrons and having consulted several squadron managers it is apparent that Value Analysis can be applied to areas within each department, beginning with the Executive Department and progressing through the Administrative and Personnel Department, Operations Department, and the Maintenance Department. A representative from each of the departments will act in the capacity of the department analyst. The group of representatives will be known as the Value Analysis Team. From the departmental level each function throughout the squadron will be included in the network. Shown below is a typical organizational arrangement and shown by dotted lines is the suggested modification in order to include the Value Analysis Team.



The senior member of the team will be selected from the Executive Department and should be the Executive Officer. His duties are to coordinate, counsel, and review the efforts of the other members. He will be the instrument through which the policy guide-lines of the Commanding Officer are disseminated to the rest of the team. In addition, his responsibility is to review the structure of the Executive Department and to assess each function within the department as to the particular contribution to the objective of the organization. Each of the other departments will provide a selected individual to act as the Value Analyst for that particular department.

III. Analyst Team Selection

Before discussing the specific functions of the analyst group it is necessary to define the criteria of selection. The problem of selecting the right man for the right job is not unique to Navy organizations. It is one of the most vital of the management functions. Choosing the right type of individual is particularly critical in the choice of a value analyst team

member. It is vital to the success of the program that requisite skills and personal attributes be recognized in view of the demands and hazards associated with the function of the job.[38] Membership on the team may be thought of as comparable to the Board of Directors of a corporation except that the final authority of the team is vested in the Commanding Officer. This "junior Board of Directors" will combine the special knowledge of each member to develop a broad reach of knowledge that can consider the multitude of technologies and functional characteristics that can be explored to produce high grade value work. The nature of this knowledge is dynamic. It is more important for the member to train himself to think in broad terms, than to develop a specific skill. He must have a practical understanding of the components of the department and of the organization.

Basic in the arena of qualifications for the analyst is the art of communications.[39] He must communicate his ideas to the appropriate people in a manner that will gain respect and professional attention. In order to do this he must have a seasoned background in the department in which he is to represent. For example, the team member from the Operations Department should be a second tour aviator that has distinguished himself in the past as an aviator and administrator. Since a large part of his function will be looking into the other person's job he should understand the principles of human relations; how to best be a critic without being an antagonizer. He should be

[38] Falcon, op. cit., p. 105.

[39] Ibid., p. 106.

vitally interested in expanding his background. He should solicit new ideas from other squadrons, study all available publications in search of new ideas, and have the ability to project new methods and ideas into workable functions for the department or squadron. In addition, he must familiarize himself with the functions of the other departments so as to appreciate inter-departmental problems, and be able to resolve this type of problem in light of the over-all benefit. Very often is the case when the Operations Department proposes a change that affects the Maintenance Department either indirectly or directly. Or the Personnel Department publishes a plan of action that requires unanticipated coordination between departments for implementation. It is these examples and many more that will test the effectiveness of the Value Team.

Creativity is an essential attribute for each of the members. The Value Analyst must have a strong imagination and give it free rein during all phases of a project.[40] A good practical creative imagination commonly includes ability to retain extensive amounts of information concerning ideas for approaches and solution to product problems, type of materials, properties of materials, processes, costs, and so forth, all arranged in a suitable order so that differing combinations may be creatively brought together and examined for applicability to problems at hand.[41] Supplemental group talents--or the attainment of a satisfactory composite ability--through an organization of individuals

[40] Ibid., p. 107.

[41] Miles, op. cit., p. 196.

of differing skills and backgrounds can be effective only when the element of creativity is present in each member of the group.[42] The analyst must maintain an open mind. It is particularly important that he not fall prey to the very human tendency to criticize or ignore the suggestions or ideas of others merely because he feels a superiority in background, knowledge, or experience. Although value analysis is an organized approach, the demand for creativity or the ability to project ideas is, at all times, critical and often the most direct measure of the ultimate benefits of the project.

From the basic definition of Value Analysis the analyst must be cost-conscious. He must be capable of deriving, analysing, and comparing costs as they relate to function.

The senior member of the team must be strong in organizational ability and internal communications. He must be the "grandaddy of salesmen". He must exercise the control to ensure that value projects are carried out in adherance to a schedule.

Essential to the over-all contribution of the team is a strong motivation toward the value approach. Experience has shown that men that have strong belief in the importance of value are much more likely to be sufficiently motivated to develop the initiative, self-drive, and enthusiasm necessary to accomplish their work well. Such strong belief also seems to be an important factor in creating emotional stability in this very frustrating type of work.[43]

[42] Falcon, op. cit., p. 107.

[43] Miles, op. cit., p. 198.

The success of a value program is largely dependent on the possession of the above attributes. Whether these attributes are possessed by each individual or are represented collectively, it is vital that they are available within the team and that they be considered with utmost care in the selection of the team members.

IV. The Plan in Motion

The initial step is to describe the fundamentals of the Value Analysis program to All Hands. All members of the squadron should be gathered together for a verbal briefing from the Commanding Officer and the Value Team on the nature of the value approach. This introduction to the program should concentrate on (1) creating attitudes favorable to Value Analysis, (2) providing historical data pertinent to the growth and wide acceptance of Value Analysis to industry and Government, and (3) discussing the philosophy and thought process of Value Analysis. It should be stressed that a certain attitude is required at all levels. This attitude must be one of enthusiasm and not one of mere acceptance or passive acknowledgment; it must be an attitude of participation. It must be an attitude of confidence in the potentials and benefits of the value approach. Sample demonstrations of the application of value techniques should be presented. These demonstrations should point out the interaction and cooperation between functions. A sample of value analysis is quoted from a recent article extracted from the NAS Lemoore Station Paper.

$294,743 Saved Per Year By New Inspection

A new jet engine inspection method, developed by the NAS Aircraft Maintenance Department has been evaluated by the Navy and certified as a savings of $294,743 per year.

The credit of this method belongs to the AMD Power Plant Division under the direction of Lt. H. W. Kennedy. The Power Plant Officer gives special praise to Del Blomquist, Pratt and Whitney Technical Representative, George Dowd, ADJ1, and D. Davis, ADJ1. These four men were primarily responsible for the new development.

The old method (referred to as the borescope) was to remove the engine from the aircraft and mount it on an installation dolly. Then the PS-3 line to the PRBC was removed and the borescope inserted. This permitted examination of the after-side of the sixth stage, rotor blades which rarely show foreign object damage. The engine was then installed on the aircraft.

In the new method it was found that the rotor blades on the first five stages of the J52 engine could be lined up so as to allow sufficient space between the blades so that a Vance light could be inserted. Thus a visual inspection for FOD could be made of the forward side of the sixth stage blades. Further, by rotation of the sixth stage by hand-crank, all 66 blades could be inspected without removing the engine from the aircraft.

The old method took a PO1, one PO2, and two ANs 16 hours each at an aggregate cost of $121.44. The new method takes one PO2 and one AN one-half hour each at a total cost of $1.81. The gross difference is $119.63 per engine.

Another advantage to the new system, and possibly the most important, is that it allows three times as many inspections--one every 25 hours.

It should be emphasized that the program will be of a continuous nature and that no one can expect "overnight" results. The departmental team analyst will be available for on the job tutoring. In that the value approach is a "modified" method of getting the job done, it should be pointed out that success of the effort will depend on each individual in the squadron.

In order to provide a systematic flow process for value proposals each department will have available blank forms titled "Value Proposals." A suggested format for this form is depicted in Appendix III. It may be necessary for the form to be modified for each department but the essentials of the form should include the name of the function under consideration, a description of the proposed change, a list of alternatives if possible, and an indication of the gain in performance of the function, or the reduction of resources as a consequence of the proposed change. These proposals will be collected by the departmental team analyst, studied for areas of improvement, evaluated in terms of the step approach of Chapter II and presented before the Value Team at the next meeting. The Value Team should meet at least once monthly and at these meetings consider all proposals submitted in the time period between sessions. The team will process each proposal in light of its contribution to the squadron objective and forward it to the Commanding Officer recommending approval or disapproval. Final acceptance is the responsibility of the Commanding Officer. After this action, a listing of all proposals will be published and promulgated to the squadron with an indication of approval or disapproval. If disapproved, the reason therefor will be stated. In the event that the proposal is classified in nature the individuals will be briefed separately if disapproved.

V. Program Incentives

A wide variety of incentive plans have been developed in industry to reward the contribution and the effectiveness of the employee. Most of these plans fall in the financial category.

Presently, it is not the policy of the Department of Defense to make available financial rewards to military personnel for a specific contribution. This is indeed, unfortunate, because financial incentive plans have proven very effective in increasing the performance of an individual, and justly so. If an employee in industry originates an idea that will provide increased profit or reduction in costs it seems logical that he should be rewarded both financially and non-financially. The subject of financial incentives in a military organization is another problem and for this paper it is necessary to restrict the incentive plan to the non-financial category.

Non-financial incentives include such things as pride in workmanship, recognition in achievement, patriotism, feeling of inclusion, gratitude, shame of poor performance, pride in superior performance, spirit of competition, and a host of other factors that tend to stimulate good performance.

In the experience of the authors, one of the strongest motivational influences on personnel is the knowledge that the management supports the program and is closely following its progress. Evidence of management interest can be shown in a number of ways such as policy statements on the subject, participation in award ceremonies recognizing individual and group contribution to the program, special liberty, and others. It is the prerogative of the Commanding Officer on how recognition or other incentive plans are to be used. It should be pointed out that fitness reports, and advancement in rating evaluations are ways to focus attention on long range financial incentives.

VI. Control

If the value program is to be successful and attain its full potential it is necessary that there be control measures built into the system. It is anticipated that many of the value proposals will encompass relatively broad changes. For such changes it may be necessary to draw up time phasing schedules, progress reporting procedures, and to establish specified goals within the constraints of the program. Control of the specific resources is important throughout the cycle of the project. It is envisioned that many labor saving and work simpliciation proposals will be forthcoming. From such ideas standards of performance can be modified to reflect future evaluations. A related method of control is a progressive evaluation of the over-all contribution of the value program. Each department can chart the effects of value changes in terms of time, effort, and economy in the use of resources. Comparative observation can be made on past readiness reports to see what benefits have transpired over time. In addition to readiness improvements, there will possibly be measurable spill-over effects in reenlistment, morale, more time for recreation and liberty, and in the general welfare of the organization.

CHAPTER V

SUMMARY AND CONCLUSIONS

This chapter includes two parts. The first part is a brief summary of the material contained in each chapter and the second part is the conclusions and recommendations of the authors.

I. Summary

The problem, as stated in chapter one, was to review the concepts of value analysis/engineering; to describe the techniques of application of value analysis; to review the present business applications; to discuss the value analysis method as a thought process; and to attempt the formulation of a method to apply value analysis procedures to a fighter squadron organization. The first four steps were for determination of applicability of value analysis to the squadron and to place its techniques in a frame of reference amenable to its organization if the technique was predicted to be effective. The final step, the purpose of the study, was an effort to provide a means by which a squadron organization could maintain itself in a more efficient condition by elimination of unnecessary tasks, improvement of procedures, and maintaining organizational structure designed to meet operational commitments with a higher level of readiness.

Research determined value analysis and value engineering to be essentially synonomous and the terms were considered as such, for purposes of this paper. The study revealed value analysis to be the result of evolution rather than revolution as one may surmise from a casual acquaintance with its results in industry. Carlos Fallon presented a definition of value analysis which was brief yet concise.

> "Value analysis/value engineering is a functionally oriented scientific method for improving product value by relating the elements of product worth to their corresponding elements of product cost in order to accomplish the required function at least cost in resources.[44]

Chapter two further clarified the concept of value analysis.

The meaning of value when used in context with value analysis was reviewed. Value itself connotates four separate terms, of which only two were applicable in the performance of a value analysis. These two terms were esteem value and use value. Esteem value was described as the features of attractiveness which cause one to want an item. Use value was described as the properties of an item which accomplished a service. A value analysis seeks to satisfy both use and esteem value at the lowest possible cost.

The steps used in employment of value analysis appeared in many forms which retained the basic process outlined by Lawrence D. Miles. The essence of Miles' procedure is to apply the following questions to a product with an intense effort to uncover all the answers.

1. What is the product?
2. How much does it cost?
3. What does it do?
4. What else would do the job?
5. What would the alternatives cost?[45]

Examination of these steps will reveal, in part, the orientation of the process toward achievement of function at the lowest possible cost.

[44]Falcon, op. cit., p. 10.

[45]Miles, op. cit., p. 18.

Present applications of value analysis were found to be oriented almost exclusively to produce improvement and purchasing of the lowest cost item which will provide the desired use and esteem value. Numerous examples were cited to illustrate the considerable success of the technique. It was noted that the Department of Defense was encouraging industrial use of value analysis on an increasing scale. Literature indicated that the primary factor in the continuing success of the value analysis technique was the dynamic approach of the process toward function. Evidence proved that value analysis was a valid method for cost reduction in the areas mentioned.

The value analysis procedure as it exists was not, in the opinion of the authors, directly applicable to an organization for use in a dynamic approach toward eliminating organizational inefficiencies and creating more effective procedures. However, the systematic process of thought and its functional orientation were believed to have merit as a tool for that purpose.

Value analysis is a thought process in its basic form which is closely related to the scientific method of problem solving. Chapter three presented this thought process as:

1. What is the problem? (must be applied to a functional item or entity)
2. What does it cost? (may be in dollars, time, manpower, etc.)
3. What is its function? (reason for existence)
4. What else would serve the same function?
5. What would the alternative cost? (may be in terms which differ from step two, but a comparative utility must be determined to equate the alternatives)

The least cost alternative will be concluded to be of higher value than all the others. Utilizing the procedure of value analysis as a thought process, the authors devised a method for implementing a value analysis program within a fighter squadron.

In Chapter IV the Commanding Officer of a Navy fighter squadron was determined to be without limitation as to the management concepts that he may use in order to improve and increase the efficiency of his command. The concept of Value Analysis and the ensuing techniques have been proven to be very effective tools in industry. The adaptation to a relatively small organization such as a fighter squadron required reduction of the value analysis technique to a thought process for functionally oriented problem solving. The process was oriented about the function of the administrative element or the individual job within the organization rather than the "product." In order to implement the plan it was considered necessary that careful preliminary planning precede the operational phase.

The thought process was transferred to a value change proposal form, which is included in Appendix III. This form, or a similar one, could be used to allow any individual in the squadron to submit an organized recommendation for a change in procedure or organizational structure. This change proposal would follow the prescribed chain of command up to the Commanding Officer for action. The Value Analyst Team, appointed by the direction of the Commanding Officer, would represent each department and act in a staff capacity on each proposal prior to reaching the Commanding Officer.

The selection criteria for the team members was keen; it is doubtful that each team member would have all of the desired attributes. However, through experience many of the desired attributes would be gained and broadened. The more predominant among these attributes were the art of communication, the art of creativeness, and the enthusiastic belief and motivation toward the value approach.

Each individual in the squadron must be briefed on the nature and purpose of Value Analysis and convinced that his particular function contributes to the over-all plan. Guidance would be provided through the value analysts of the respective departments. Through the process of value change proposals the acceptance process would provide careful analysis, judgement, and feed-back.

Incentive and control programs should be designed at the discretion of the Commanding Officer. The incentive plan must, by regulation, fall in the non-financial category. However, as the value plan gathers momentum spill-over and fringe effect should be apparent in the areas of morale, teamwork, and self-satisfaction. More far reaching long run effects would be the development of more conscientious, more capable thinkers and leaders for the future generation of the Navy.

II. Comments and Conclusions

The squadron application described is rudimentary in nature. It was considered necessary to construct it in this manner to enhance the changes of initial acceptance by a squadron commanding officer. Fleet squadrons are generally overloaded with details and commitments as it is and programs which are unproven are justly met

with a degree of skepticism. It was the intention of the paper to provide a proposal which appears to be workable, requires a minimum of time, and should produce results in a relatively short period of time. Since it was beyond the scope of this study, the recommended program remains untested.

Value analysis concepts have not yet been employed for the entire spectrum of possible applications. The authors believe that value analysis could be integrated into an organization for the purposes of eliminating tasks which do not contribute to progress toward predetermined goals. Minor organizational structure changes may also be found advantageous through the technique.

Application of value analysis as proposed would serve many fringe benefits to the squadron. Use of the technique teaches methodical thought process which encourages creativity. This thought process may aid the individual to be of greater service in all of his endeavors. The use of the value analysis team may be a positive morale factor in that it brings the organization's personnel together in an effort to eliminate unnecessary tasks and create more efficient methods of job performance. Results should be realized in a matter of months providing "feedback" and creating a sense of accomplishment. In the long run the organization should realize a more efficient use of resources.

Value analysis also equips its military proponents with a mode of thinking which is similar to the many analysis techniques employed and promoted by leaders in the Department of Defense. This will be beneficial when change proposals are submitted to higher command using a "universal" analytic thought process.

This particular study of value analysis may be used by persons who wish to expand knowledge in the area of organizational application by testing the proposed program with the cooperation of an operational fighter squadron. The program could, at that time, be refined with the goal of a higher level of effectiveness. Additionally, the study may serve to introduce persons to the concepts of value analysis providing an insight to possible military applications.

Finally, if man succeeds in not using the tremendously destructive weapons which are available today, his survival may turn to his ability to gain greatest benefit from his limited resources. Value analysis presents a sound basic technique which permits the maximum employment of human creative endeavor toward that end.

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APPENDIX I

The following case analysis is reproduced from Techniques of Value Analysis and Engineering, by Lawrence D. Miles. (pg 21-23)

The Planned Approach

Value analysis presupposes the use of a planned approach for intensive and effective utilization of every applicable technique to overcome "stoppers." This requires the development of sufficient skill in the application of enough techniques to bring into clear view a liberal number of value alternatives.

The soundness of this statement may be illustrated by a look at the following case involving a strip hinge.

What is the item? A metal strip hinge about 8 inches long has holes in the flattened portion for fastening it on a door and has one edge rolled so that a hinge pin can be inserted. It is made by stamping and forming, by a manufacturer who has proved his reliability in the field of hardware, in quantities of 500,000 per year.

What does it do? The item mounts a door on an appliance; the requirements are that it must be rugged and reliable, must be made uniformly enough to permit ready and reliable assembly, and must come from proven source. Lack of the hinge would stop the entire appliance production line with resulting work delays for thousands of people and large amounts of unexpected cost for the manufacturer.

What else would do the job?

1. Use other manufacturers' hinges. This solution was thought to be not too promising because purchasing had already secured quotations from others and had made a selection of the lowest cost

reliable supplier. His facilities and his ability to meet schedules had been examined. He had proven himself. To study the value of this item again was judged by many to be ill-advised.

2. Make it of a different material-plastics, for example. Great resistance existed against even an investigation of this approach because, during the developing technology in the plastics field, many of the wrong plastics had been misapplied and none with appropriate properties for this hinge had come sharply into view of the decision makers. There were fears of loss of customer confidence and of costly replacements. All of these and other considerations tended to prevent a thorough investigation of modern or available plastics which might accomplish the job.

3. Cast the hinge strip. Admittedly the quantities were satisfactory to make this or almost any other high-volume process practicable. Those experienced in the art of casting pointed out that the hinge strip comprised relatively thin strips over large areas; basically, this is not a design type in which castings excel. It was also pointed out that the need for the long hole would mean a very long and tricky coring or an equally difficult long-hole drilling operation for the hinge pin. Experience in the past caused casting specialists to believe that it would not be worthwhile to develop alternatives for these parts made as castings, and that was the stand they took when asked for specific information.

4. Make as a forging. Here the problem of drilling the long, relatively straight hole for the hinge pin discouraged effective work in providing alternatives in the form of forgings.

5. Weld a strip of metal edgewise to a piece of tubing. Here, hardware and hinge engineers were concerned about the quality of

the weld, the amount of flash, the deformation that would take place at welding, and the appearance of the finished job. Costs by usual welding processes would work out to be too high. To develop it and plan it through with special jigs and equipment would require time and study, and welding men believed that this was not the way to do the job anyhow. Therefore, it was very difficult, if not impossible, to get a useful estimate of the cost of tooling and of the finished parts. The estimate, to be useful, should be correct to within plus or minus 5 or 10 percent.

6. Pass a strip of steel through continuous rolls and roll on the edge of the strip the section that would accommodate the hinge pin. Hardware engineers were concerned with the "spring-back," the variations in tolerance and dimension, and the burrs which would result as the continuous strip was cut into short segments. Then there was the possible necessity for additional operations to bore out, or ream out, the hinge-pin hole and to punch holes in the flat section. Maintenance of the roll equipment was another foreseen problem, as was the question of whether steel or the thickness required could be rolled out properly. All these considerations tended to retard or prevent the preparation of any objective proposals showing the approximate costs of a strip made by this method.

Numerous other alternatives can be brought into view and they all must satisfy similar objections before one can proceed with a useful evaluation study.

It will be readily seen from the foregoing that the value specialist's problem is to:

Understand and apply each applicable step of an orderly planned approach.

Expect that, when requesting the development of new value alternatives, men who customarily make decisions in their own field and accordingly are not used to seeing the materials or processes used differently will feel that the approach is wrong. Hence, they will be very hesitant about investing their important time in serious considerations for the preparation of objective value alternatives.

In value analysis, however, it is essential that this sort of normal negative not be allowed to stop the development of appropriate information. Numerous are the examples in which large improvements have been made promptly after overcoming this type of reluctance and actually securing meaningful value alternatives.

What would that alternative cost? In the case of the hinge, continuing steadfast and effective development of the suggested alternatives brought into focus information which proved the last alternative very practical. The result was a 10 cent reduction in the cost of each hinge, and thus the payoff was $50,000.

APPENDIX II

An Extract from

FRINGE EFFECTS OF VALUE ENGINEERING

FRINGE EFFECTS OF VALUE ENGINEERING

A Report by the

Technical Subcommittee

of the

Special Committee on Value Engineering

AMERICAN ORDNANCE ASSOCIATION

for

THE OFFICE OF THE ASSISTANT SECRETARY OF DEFENSE

(INSTALLATIONS AND LOGISTICS)

MAY 1964

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FRINGE EFFECTS OF VALUE ENGINEERING

A Report Of Survey By

VALUE ENGINEERING TECHNICAL SUBCOMMITTEE

AMERICAN ORDNANCE ASSOCIATION

MAY, 1964

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A. F. Kaufmann - International Business Machines Corp.
H. I. Knight - Chance Vought Corporation
S. G. Kratzert - General Electric Company
J. H. Martin - General Electric Company
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(Continued)

CONTRIBUTORS (CONT'D)

E. P. Noris	- The Bendix Corporation
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INTRODUCTION

BY

DR. C. C. VAN VECHTEN, CHAIRMAN
SPECIAL COMMITTEE ON VALUE ENGINEERING

IN OCTOBER, 1963, A LETTER FROM MR. G. E. FOUCH, DEPUTY ASSISTANT SECRETARY OF DEFENSE, STATED THAT THE DEPARTMENT OF DEFENSE IS CURRENTLY TAKING STEPS TO GREATLY INCREASE THE APPLICATION OF VALUE ENGINEERING TECHNIQUES TO DEFENSE EQUIPMENT AND SUPPLIES. SINCE IT IS A WIDESPREAD FEELING AMONG PERSONS NOT DIRECTLY INVOLVED IN VALUE ENGINEERING WORK THAT VALUE ENGINEERING "CHEAPENS" A PRODUCT AND LOWERS ITS PERFORMANCE CAPABILITIES, IT WAS REQUESTED THAT THE AMERICAN ORDNANCE ASSOCIATION UNDERTAKE A STUDY OF REPRESENTATIVE ITEMS, ARBITRARILY SELECTED, TO DETERMINE WHETHER OR NOT THIS FEELING WAS TRUE. IT WAS FURTHER SUGGESTED THAT THE STUDY DOCUMENT THE IMPACT IN TERMS OF SUCH FACTORS AS RELIABILITY, MAINTAINABILITY AND OTHER FRINGE EFFECTS.

THE SPECIAL COMMITTEE ON VALUE ENGINEERING WASTED LITTLE TIME IN ESTABLISHING THE SURVEY FORMAT AND BOUNDARIES AND ACTUALLY APPLIED VALUE ENGINEERING PRINCIPLES TO PREPARATION OF THE SURVEY. AS AN UNBIASED GROUP, THE COMMITTEE WANTED TO KNOW THE TRUTH FOR THEMSELVES.

SOME OF THE PROBLEMS ENCOUNTERED IN PREPARING THIS SURVEY WERE ONES OF DEFINITION. FOR EXAMPLE, ALTHOUGH IT IS CLEAR WHAT THE DIFFERENCE IS BETWEEN A CLASS I AND A CLASS II CHANGE TO THE INDIVIDUAL CONTRACTOR, IT IS POSSIBLE THAT A CLASS I CHANGE FOR A SUBCONTRACTOR WOULD BE A CLASS II CHANGE FOR A PRIME CONTRACTOR. THE GROUND RULES ESTABLISHED TO THIS PROBLEM WERE: IF THE CHANGE NECESSITATED A MODIFICATION TO THE PRIME CONTRACT, IT WAS COUNTED AS A CLASS I CHANGE. IF THE CHANGE DID NOT REQUIRE A CONTRACT MODIFICATION TO THE PRIME CONTRACT, IT WAS COUNTED AS A CLASS II CHANGE.

THIS SURVEY WAS COMPLETED AND PRESENTED TO THE DOD IN-HOUSE VALUE ENGINEERING CONFERENCE AT THE PENTAGON ON FEBRUARY 18, 1964.

METHOD OF SURVEY

THE PURPOSE OF THIS SURVEY WAS NOT TO MEASURE THE COST SAVINGS RESULTING FROM VALUE ENGINEERING EFFORT OR TO GIVE FINE EXAMPLES OF VALUE ENGINEERING AT ITS BEST. ITS TRUE PURPOSE, AS MENTIONED IN THE INTRODUCTION, WAS TO FIND OUT IF THERE WERE GOOD OR BAD SIDE EFFECTS FROM VALUE ENGINEERING CHANGES.

THE FRINGE EFFECTS EVALUATED WERE:

RELIABILITY	PARTS AVAILABILITY	LOGISTICS
MAINTAINABILITY	LEAD TIME	PERFORMANCE
PRODUCIBILITY	QUALITY	PACKAGING
HUMAN FACTORS	WEIGHT	

THESE WERE SORTED AS TO:

FIELD PROVEN ADVANTAGES

ADVANTAGES BY ENGINEERING JUDGMENT

NO EFFECT

TRADE-OFF DISADVANTAGE

RESCINDED DUE TO DISADVANTAGES

DOCUMENTED FEEDBACK WAS USED WHERE AVAILABLE TO EVALUATE THESE EFFECTS. WHERE UNAVAILABLE, THE BEST JUDGMENTS OF THE "VALUE, DESIGN, RELIABILITY, AND FIELD SERVICE ENGINEERS OR MANAGERS" WERE USED.

IT WAS DETERMINED AT THE INITIAL PLANNING MEETING FOR THIS SURVEY THAT MEANINGFUL AND UNBIASED DATA COULD BE GATHERED FROM PARTICIPATING COMPANIES ONLY IF THE TOTAL POPULATION OF VALUE ENGINEERING CHANGES WAS ANALYZED AND SUBJECTED TO RANDOM SAMPLING. SECONDLY, SINCE IT WAS KNOWN THAT MAJOR VALUE ENGINEERING PROGRAMS HAVE BEEN IN EXISTENCE FOR APPROXIMATELY ONLY FOUR YEARS, DATA WAS REQUESTED FOR THE CALENDAR YEARS 1959 THROUGH 1962. FEEDBACK FROM CHANGES INSTITUTED DURING 1963 WOULD BE INSUFFICIENT TO PROVIDE RELIABLE CONCLUSIONS AS OF THE TIME OF SURVEY (NOVEMBER, 1963).

TWENTY-EIGHT MEMBER COMPANIES OF THE AOA SPECIAL COMMITTEE ON VALUE ENGINEERING WERE INVITED TO PARTICIPATE. SIXTEEN COMPANIES AND ONE MILITARY ARSENAL RESPONDED. OF THESE, THIRTEEN SUPPLIED USABLE STATISTICAL DETAIL.

VALUE ENGINEERING PROPOSALS RESULTING FROM SEMINARS OR OTHER VALUE ACTIVITIES WERE COUNTED IN THIS SURVEY ONLY IF THEY HAD BEEN FORMALLY SUBMITTED TO COMPANY MANAGEMENT OR MILITARY CUSTOMERS. THESE PROPOSALS WERE THEN SUBDIVIDED INTO CLASS I (REQUIRING CONTRACT ECP APPROVAL) AND CLASS II (NOT REQUIRING ECP APPROVAL). COMMERCIAL PRODUCT CHANGES WERE NOT INCLUDED.

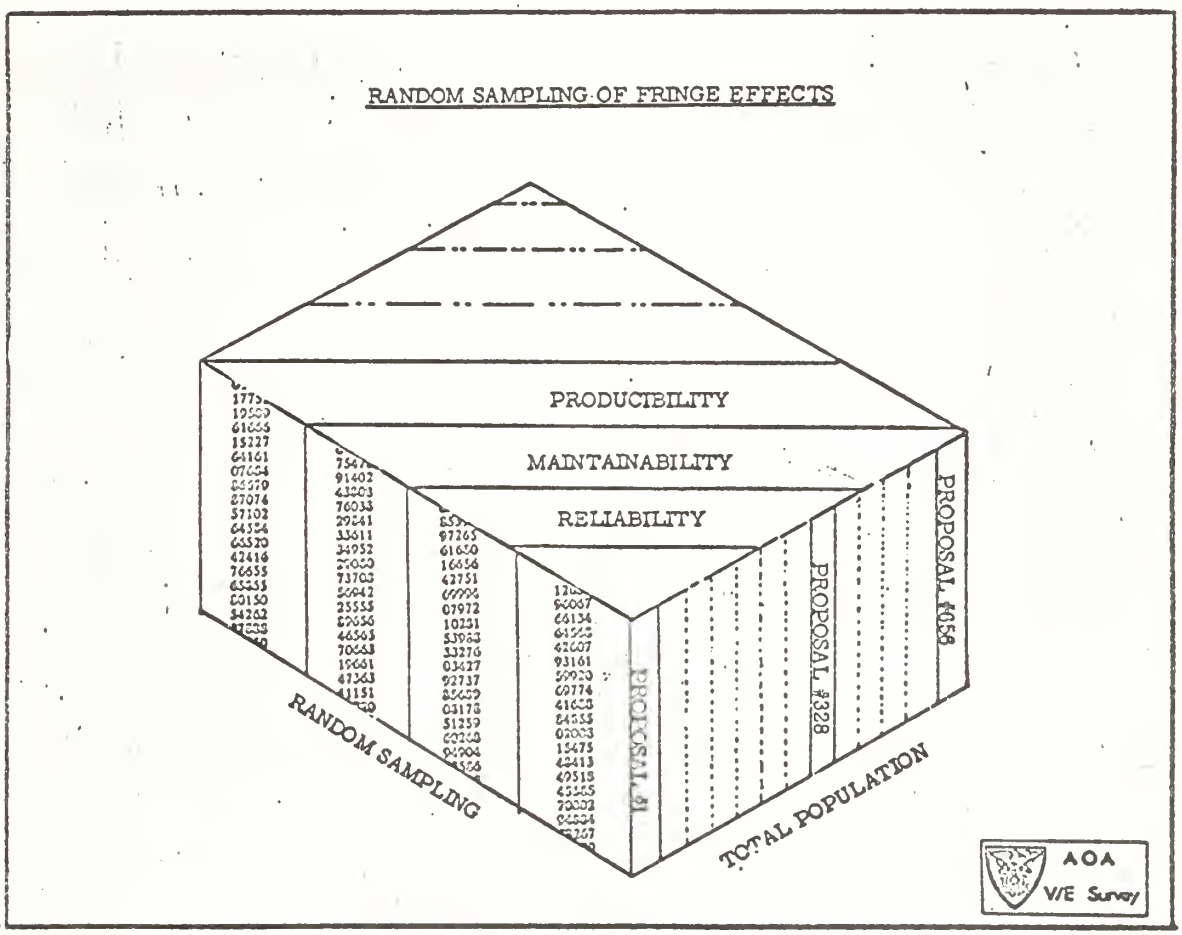
CONTINUED. . . .

Insufficient data excluded the years 1959 and 1960 from the following detail but not from fringe effect sampling. Proposed changes formally submitted were subdivided into those which were implemented and those which were rejected. The third category included those proposals which resulted in no action due to any reason.

	1961	1962	Total	%
Proposals Implemented	189	467	656	39%
Proposals Rejected	85	255	340	20%
No Action or Pending	50	645	695	41%
V/E Change Proposals Surveyed	324	1,367	1,691	100%

SAMPLING METHOD

From the implemented changes in the total population, each company was requested to supply ten random samples which would be used to evaluate the fringe effects. These samples were selected by applying a consecutive numbering system to the implemented changes and then utilizing the sampling table from MIL Standard 105 "Sample Procedures and Tables for Inspection by Attributes". One hundred twenty-four samples were received and subdivided into 26 Class I Changes and 98 Class II Changes. A flow chart indicating the random sampling method is shown below.



To illustrate the detail gathered in each random sample, a format copy is included on the following page.

VALUE ENGINEERING "FRINGE EFFECT" SURVEY FORMAT

Fringe Effect *	Field Proven Advantage	Advantage By Eng. Judgment	No Effect	Trade-Off Disadvantage	If Change Was Initially Approved & Later Rescinded Check Reason(s) Why
Reliability					
Maintainability					
Producibility					
Human Factors					
Parts Availability					
Production Lead Time					
Quality					
Weight					
Logistics					
Performance					
Packaging					
Other (Specify)					

*** List Quantitative Changes Where Possible**

QUANTITIES COLLATED FOR EACH FRINGE EFFECT WERE SORTED AND CONVERTED INTO A PERCENT OF TOTAL. DISTRIBUTION PIE-CHARTS WERE MADE FROM THESE PERCENTAGES AND ARE SHOWN IN THE FINDINGS.

FOR DEMONSTRATION PURPOSES, EACH COMPANY WAS REQUESTED TO SELECT ONE SAMPLE SHOWING SIGNIFICANT FRINGE EFFECTS FROM ITS TEN RANDOM SAMPLES. IT WAS REQUESTED THAT THIS EXAMPLE BE CLEAR, SIMPLE, AND READILY UNDERSTOOD BY THE LAITY. WRITTEN DETAIL SUPPORTED THE EXAMPLE ALONG WITH PHOTOGRAPHS OR ARTWORK. THIS INFORMATION INCLUDED:

A) NATURE OF THE CHANGE (BEFORE AND AFTER)
B) THE END MILITARY ITEM(S) TO WHICH THE CHANGE APPLIED
C) LENGTH OF TIME THE CHANGE HAS BEEN IN EFFECT
D) APPROXIMATE COST BENEFIT FROM THE CHANGE

DEFINITIONS OF FRINGE EFFECTS

1. RELIABILITY - ABILITY TO MEET PERFORMANCE REQUIREMENTS FOR A DETERMINED NUMBER OF TIMES.

2. MAINTAINABILITY - RELATIVE EASE OF REPAIR OR REPLACEMENT.

3. PRODUCIBILITY - RELATIVE EASE OF REPEATABLE MANUFACTURE.

4. HUMAN FACTORS - ACCEPTABILITY OF CHANGE RELATED TO NECESSARY EDUCATION OR DEXTERITY.

5. PARTS AVAILABILITY - RELATIVE EASE IN OBTAINING OR MANUFACTURING SIMPLIFIED OR STANDARD PARTS.

6. PRODUCTION LEAD TIME - ELIMINATION, STANDARDIZATION OR SIMPLIFICATION OF OPERATIONS OR MATERIALS.

7. QUALITY - CHARACTERISTICS OF PARTS TO MEET EVERYTHING SPECIFIED CONSISTENTLY.

8. WEIGHT - LIGHTER IN WEIGHT.

9. LOGISTICS - QUANTITY AND COMPLEXITY OF PARTS NEEDED FOR FIELD SUPPORT OF END ITEMS.

10. PERFORMANCE - ABILITY OF THE CHANGE TO CARRY OUT THE INTENDED FUNCTION AT TIME OF INITIAL TEST OR QUALIFICATION.

11. PACKAGING - RELATIVE EASE OF PROTECTING PARTS UNTIL READY FOR USE.

AOA
V/E Survey

AOA FRINGE EFFECT SURVEY
PARTICIPATING COMPANIES

BENDIX CORPORATION

CHRYSLER CORPORATION

GENERAL DYNAMICS CORPORATION

GENERAL ELECTRIC COMPANY

GENERAL PRECISION, INC.

INTERNATIONAL BUSINESS MACHINES CORP.

LING-TEMCO-VOUGHT, INC.

LOCKHEED AIRCRAFT CORPORATION

MARQUARDT CORPORATION

MARTIN COMPANY

NORTH AMERICAN AVIATION, INC.

THOMPSON-RAMO-WOOLDRIDGE, INC.

VITRO CORPORATION OF AMERICA

WATERVLIET ARSENAL

FINDINGS

A NOTEWORTHY SEGREGATION OF SURVEY DETAIL IS SEEN IN THE SUBDIVISION OF CLASS I AND CLASS II V/E CHANGE PROPOSALS. THE SURVEY REQUESTED THE NUMBER OF V/E CHANGES FORMALLY PROPOSED FOR THE CALENDAR YEARS 1959, 1960, 1961 AND 1962. THESE WERE SUBDIVIDED INTO CLASS I AND CLASS II CHANGES. SO FEW CHANGES WERE PROPOSED IN 1959 AND 1960 THAT THESE STATISTICS WERE OMITTED FROM THE DATA SO AS NOT TO DISTORT IT.

PROPOSED V/E CHANGES SURVEYED

	1961	1962	TOTAL	%
CLASS I	45	250	295	17%
CLASS II	279	1,117	1,396	83%
TOTAL POPULATION SURVEYED	324	1,367	1,691	100%

IT IS OF SIGNIFICANT IMPORTANCE TO NOTE THAT THERE WERE FIVE TIMES AS MANY CLASS II CHANGES PROPOSED AS THERE WERE CLASS I.

V/E CHANGES IMPLEMENTED

	1961	1962	TOTAL	% OF THOSE PROPOSED
CLASS I	29	57	86	29%
CLASS II	160	410	570	41%
IMPLEMENTED CHANGES SAMPLED	189	467	656	

FRINGE EFFECT SAMPLING CAME FROM THIS GROUP.

V/E CHANGES REJECTED

	1961	1962	TOTAL	% OF THOSE PROPOSED
CLASS I	6	37	43	15%
CLASS II	79	218	297	21%
REJECTED FROM TOTAL POPULATION	85	255	340	

ONLY 20% OF ALL V/E CHANGES FORMALLY PROPOSED WERE REJECTED.

V/E CHANGES - NO ACTION OR PENDING

	1961	1962	TOTAL	% OF THOSE PROPOSED
CLASS I	10	154	164	56%
CLASS II	40	491	531	38%
TOTAL NO ACTIONS OR PENDING	50	645	695	

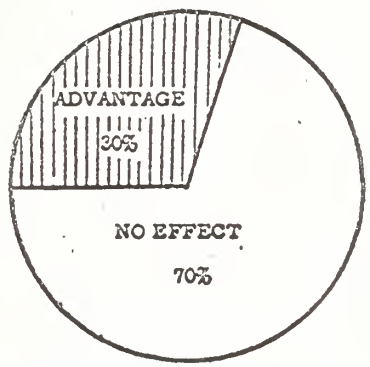
AS OF THE DATE OF SURVEY (NOVEMBER, 1963), MORE CHANGES WERE PENDING THAN WERE IMPLEMENTED.

DATA GATHERED FROM ANALYSIS AND COLLATION OF FRINGE EFFECTS STUDIED ARE ILLUSTRATED IN THE PIE-CHARTS ON THE FOLLOWING PAGES. EACH CHART SEGREGATES THE FRINGE EFFECT BETWEEN CLASS I AND CLASS II AND SUB-NOTES THE DISTRIBUTION OF ADVANTAGES BETWEEN "FIELD PROVEN" AND THOSE BY "ENGINEERING JUDGMENT". A CONSOLIDATION OF CLASS I AND CLASS II CHANGES FOLLOW THE PIE-CHARTS.

V/E EFFECTS UPON

RELIABILITY

CLASS I CHANGES



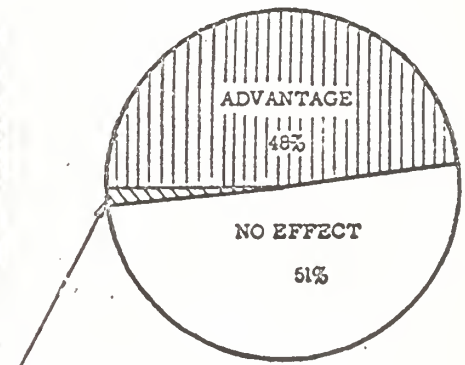
DISADVANTAGES - NONE

ADVANTAGE - FIELD PROVEN - 15%

ENG. JUDGMENT - 15%

30%

CLASS II CHANGES



DISADVANTAGES - 1%

ADVANTAGE - FIELD PROVEN - 16%

ENG. JUDGMENT - 32%

48%

AOA
V/E Survey

V/E EFFECTS UPON

MAINTAINABILITY

CLASS I CHANGES

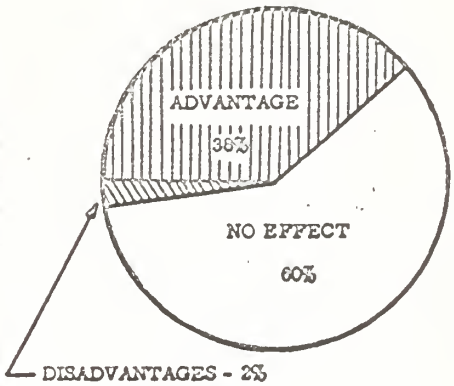
DISADVANTAGES - NONE

ADVANTAGE - FIELD PROVEN - 35%

ENG. JUDGMENT - 15%

50%

CLASS II CHANGES



DISADVANTAGES - 2%

ADVANTAGE - FIELD PROVEN - 15%

ENG. JUDGMENT - 23%

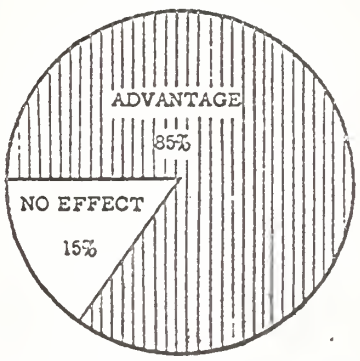
38%

AOA V/E Survey

V/E EFFECTS UPON

PRODUCIBILITY

CLASS I CHANGES



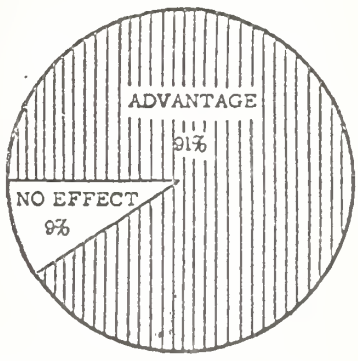
DISADVANTAGES - NONE

ADVANTAGE - FIELD PROVEN - 39%

ENG. JUDGMENT - 46%

85%

CLASS II CHANGES



DISADVANTAGES - NONE

ADVANTAGE - FIELD PROVEN - 45%

ENG. JUDGMENT - 46%

91%

AOA V/E Survey

V/E EFFECTS UPON

HUMAN FACTORS

CLASS I CHANGES

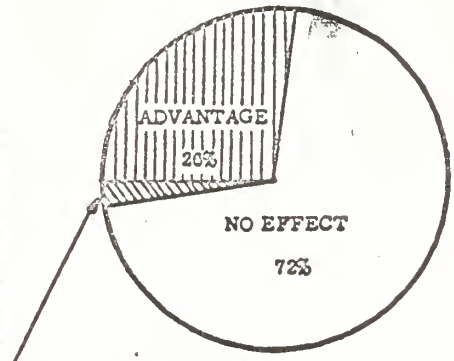
DISADVANTAGES - NONE

ADVANTAGE - FIELD PROVEN - 15%

ENG. JUDGMENT - 4%

19%

CLASS II CHANGES



DISADVANTAGES - 2%

ADVANTAGE - FIELD PROVEN - 14%

ENG. JUDGMENT - 12%

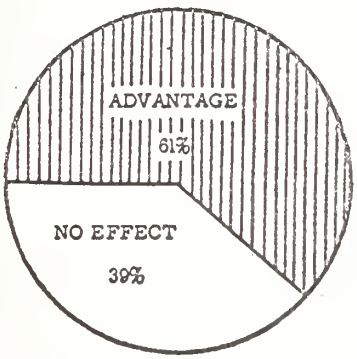
26%

AOA V/E Survey

V/E EFFECTS UPON

PARTS AVAILABILITY

CLASS I CHANGES



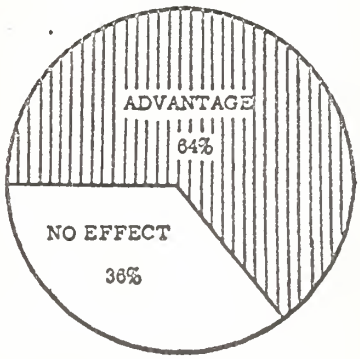
DISADVANTAGES - NONE

ADVANTAGE - FIELD PROVEN - 50%

ENG. JUDGMENT - 11%

61%

CLASS II CHANGES



DISADVANTAGES - NONE

ADVANTAGE - FIELD PROVEN - 33%

ENG. JUDGMENT - 31%

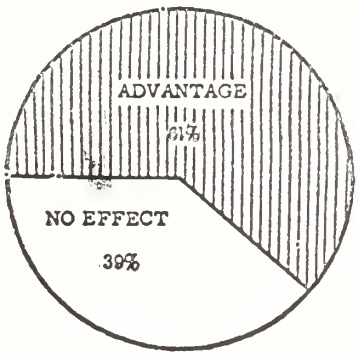
64%

AOA V/E Survey

V/E EFFECTS UPON

PRODUCTION LEAD TIME

CLASS I CHANGES



DISADVANTAGES - NONE

ADVANTAGE - FIELD PROVEN - 46%

ENG. JUDGMENT - 15%

61%

CLASS II CHANGES

DISADVANTAGES - NONE

ADVANTAGE - FIELD PROVEN - 38%

ENG. JUDGMENT - 42%

80%

AOA V/E Survey

V/E EFFECTS UPON

QUALITY

CLASS I CHANGES

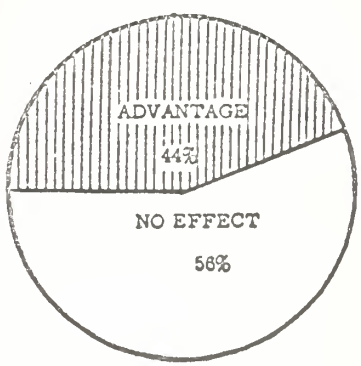
DISADVANTAGES - NONE

ADVANTAGE - FIELD PROVEN - 4%

ENG. JUDGMENT - 11%

15%

CLASS II CHANGES



DISADVANTAGES - NONE

ADVANTAGE - FIELD PROVEN - 13%

ENG. JUDGMENT - 31%

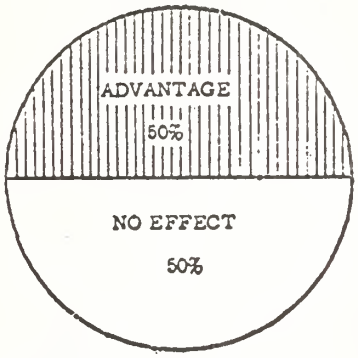
44%

AOA V/E Survey

V/E EFFECTS UPON

WEIGHT

CLASS I CHANGES



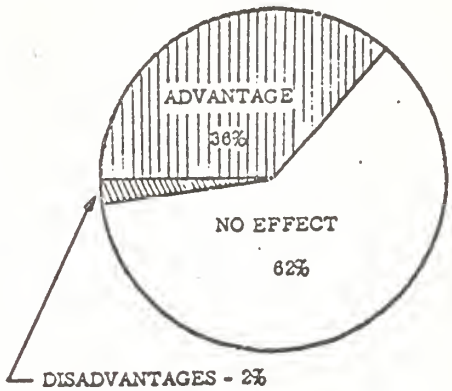
DISADVANTAGES - NONE

ADVANTAGE - FIELD PROVEN - 19%

ENG. JUDGMENT - 31%

50%

CLASS II CHANGES



DISADVANTAGES - 2%

ADVANTAGE - FIELD PROVEN - 6%

ENG. JUDGMENT - 30%

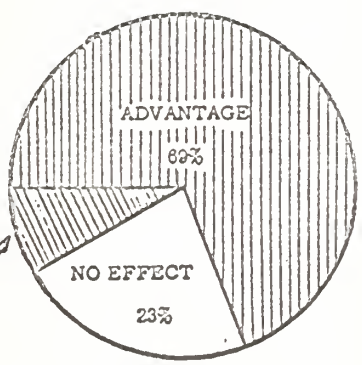
36%

AOA V/E Survey

V/E EFFECTS UPON

LOGISTICS

CLASS I CHANGES



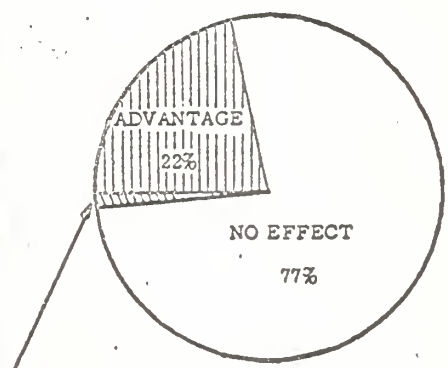
DISADVANTAGES - 8%

ADVANTAGE - FIELD PROVEN - 54%

ENG. JUDGMENT - 15%

69%

CLASS II CHANGES



DISADVANTAGES - 1%

ADVANTAGE - FIELD PROVEN - 13%

ENG. JUDGMENT - 9%

22%

AOA V/E Survey

V/E EFFECTS UPON

PERFORMANCE

CLASS I CHANGES

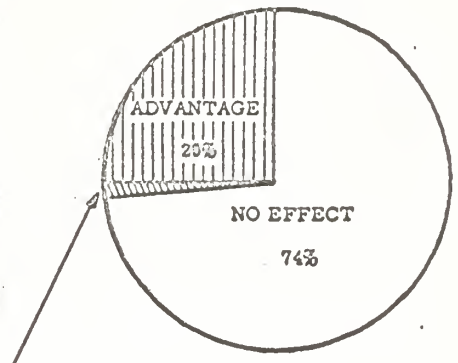
DISADVANTAGES - NONE

ADVANTAGE - FIELD PROVEN - --

ENG. JUDGMENT - 8%

8%

CLASS II CHANGES



DISADVANTAGES - 1%

ADVANTAGES - FIELD PROVEN - 14%

ENG. JUDGMENT - 11%

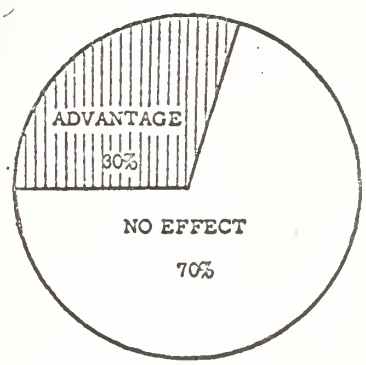
25%

AOA V/E Survey

V/E EFFECTS UPON

PACKAGING

CLASS I CHANGES



DISADVANTAGES - NONE

ADVANTAGE - FIELD PROVEN - 19%

ENG. JUDGMENT - 11%

30%

CLASS II CHANGES

DISADVANTAGES - NONE

ADVANTAGE - FIELD PROVEN - 6%

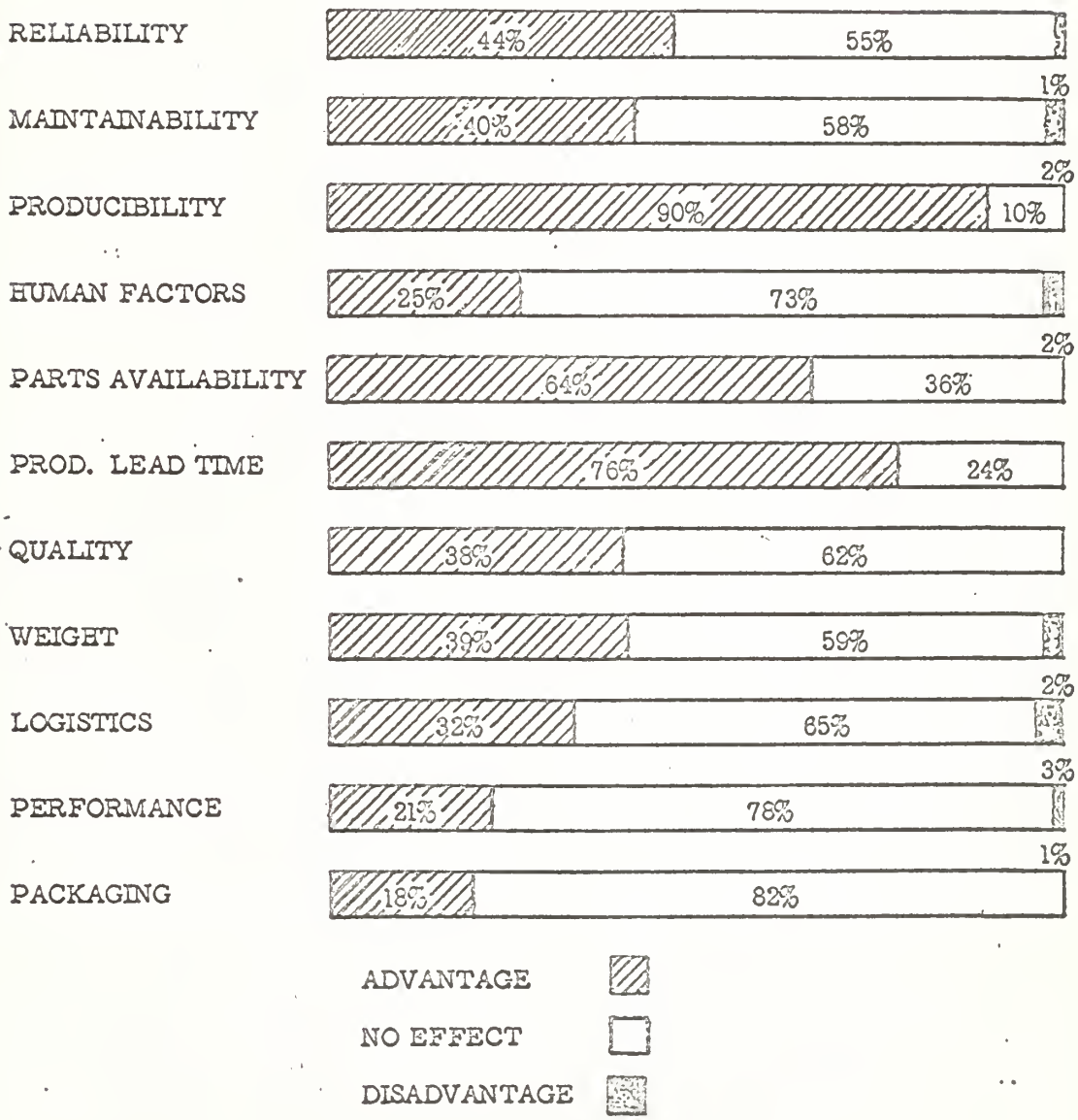
ENG. JUDGMENT - 8%

14%

AOA V/E Survey

V/E FRINGE EFFECTS

(CLASS I & CLASS II CHANGES CONSOLIDATED)



CONCLUSIONS

DATA FEEDBACK FOR V/E CHANGES REPORTED BY ALL PARTICIPANTS INDICATE A PROVEN RECORD OF IMPROVEMENTS OR NO CHANGE ON FRINGE EFFECTS MEASURED. SECONDLY, TRADE-OFF DISADVANTAGES AMOUNTED TO LESS THAN 1% OF THE TOTAL FRINGE EFFECTS MEASURED.

ALTHOUGH THE INTENT OF THIS SURVEY WAS NOT TO MEASURE COST SAVING ACCOMPLISHMENTS ON SPECIFIC VALUE ENGINEERING CHANGES, THE DOD V/E COUNCIL SUGGESTED THAT THIS SURVEY ACCUMULATE TOTAL SAVINGS BY CONTRACT FOR CLASS I VERSUS CLASS II CHANGES. THE FOLLOWING EXHIBIT SHOWS THAT THE AVERAGE CLASS I CHANGE PER CONTRACT WAS WORTH APPROXIMATELY TWICE AS MUCH AS THE AVERAGE CLASS II CHANGE. OF SIGNIFICANT IMPORTANCE WAS THE FACT THAT THERE WERE 6.6 TIMES AS MANY CLASS II CHANGES (570) IMPLEMENTED DURING 1961 AND 1962 VERSUS CLASS I (86).

AVERAGE SAVINGS

	CLASS I	CLASS II
NUMBER OF IMPLEMENTED CHANGES	148	569
CONTRACT SAVINGS	$3,572,000	$6,526,000
AVERAGE SAVINGS PER CHANGE	$ 24,000	$ 11,500

CLASS II CHANGES INDICATE A FAR MORE FERTILE FIELD OF SAVINGS THAN CLASS I.

ALTHOUGH IT IS BELIEVED THAT THIS SURVEY IS THE FIRST OF ITS KIND AND THEREFORE SUBJECT TO POSSIBLE ERRORS IN HUMAN JUDGMENT, THE EVIDENCE IS SO HEAVILY DIRECTED TOWARDS IMPROVEMENTS IN ALL MEASURED AREAS THAT VALUE ENGINEERING MUST BE LOOKED UPON AS ONE OF THE MORE IMPORTANT TOOLS THAT GOVERNMENT AND INDUSTRY HAS AT ITS DISPOSAL.

THE OVERWHELMING COST SAVINGS LINKED TO THESE FRINGE EFFECT IMPROVEMENTS ARE UNDERSTANDABLE FROM THE ROLE WHICH VALUE ENGINEERING PLAYS AND MAY BE DESCRIBED IN A SINGLE WORD - - - SIMPLICITY.

* U. S. GOVERNMENT PRINTING OFFICE : 1964 O - 746-662

APPENDIX III

VALUE PROPOSAL

Department	Ident. of Function	Date

Present (Include short description of function, present cost in man-hours, material, etc.)	Proposed (describe in detail, use sketches, pictures, and additional sheets as necessary. List alternatives as applicable)

Net Increase in Performance

Net Savings in Manpower, Materials, Budget

Proposed By:	Date Reviewed by Team:

Final Action: Recommended for Approval_____
Recommended for Disapproval_____

Reason for Disapproval:

_____
Commanding Officer